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EDITOR'S PAGE

Why All the Focus on Cardiac Imaging?

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Cardiovascular (CV) imaging has become the focus of numerous efforts on the part of public and private payers to constrain further growth in utilization of noninvasive services. The purpose of this brief report is to review the growth of CV imaging, detail recent changes in patterns of growth, discuss possible underlying reasons, and anticipate appropriate responses. This brief report will be one of our periodic reviews detailing important trends in CV imaging services.

Cardiac Imaging Utilization Growth Over the Last Decade

The U.S. has experienced significant growth in national health expenditures, averaging 4.8% per year from 1960 to 2006 (1). Today, much of the growth in spending is not only related to coronary heart disease but to most chronic conditions including diabetes, arthritis, hypertension, and kidney disease (2). The growth in spending for imaging parallels an increase in spending for chronic conditions including payments to orthopedic surgeons, radiologists, and cardiologists, to name a few (2). As is illustrated in Figure 1, payments for imaging services to cardiologists represent a small proportion of payments for all of imaging and reflects the diverse needs of the Medicare population (3). In the year 2000, the total payment to cardiologists was $1.6 billion and increased by more than 200% to $5.1 billion in 2006. In 2006, only 36% of total Medicare Part B revenues were paid to cardiologists for in-office imaging services (3). This payment to cardiologists for imaging services represents 8.7% of total payments for all physician services in 2006 (4). When including estimates of payments by private health insurance, the total expenditures related to CV imaging are estimated to approach $17 billion (5).

CV imaging procedures are commonly listed within the leading 200 Medicare expenditures. Figures 2 and 3 plot the trends of leading Medicare charges for current procedural codes for myocardial perfusion single-photon emission computed tomography (SPECT), echocardiography, exercise testing (without imaging), and cardiac catheterization (6). The growth in the utilization of echocardiography and myocardial perfusion SPECT was substantially higher than that reported for exercise testing (without imaging) and for left heart catheterization.

Advanced imaging techniques, such as cardiovascular magnetic resonance, positron emission tomography, and cardiac computed tomography (CT) have not realized the growth in imaging utilization to the same extent as echocardiography and nuclear cardiology (Fig. 4) (7). Of the 3 procedures, cardiac CT has experienced the greatest growth. From 2000 to 2005, the utilization grew from 0.31 to 1.21 CT procedures performed for every 1,000 Medicare patients. A more detailed description of specific utilization by CT codes noted a modicum of growth for these procedures (data provided by the Society of Cardiovascular CT) (Table 1).

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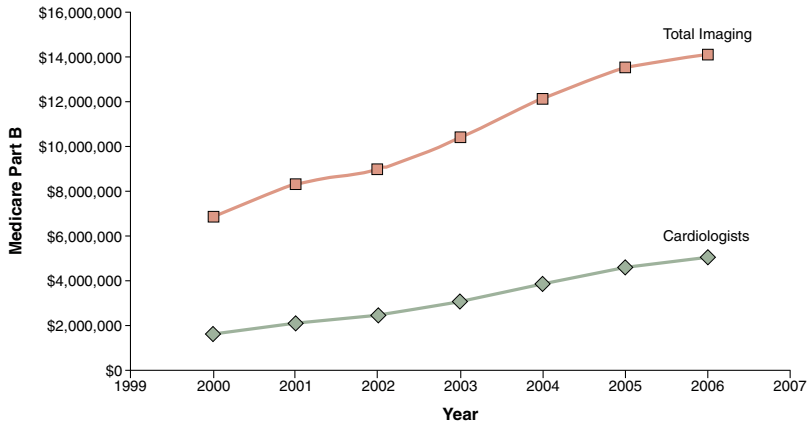

Figure 1. Medicare Fee-for-Service Spending for Imaging Services Paid to Cardiologists

Adapted from GAO, Medicare Part B Imaging Services (3). CT = computed tomography; MR = magnetic resonance; PET = positron emission tomography.

Substantive growth in utilization with CT is quite possible in the next decade.

The trends in increasing utilization were commented on in Government Accounting Office reports as early as 2002, and culminated in a detailed evaluation of spending growth in all of imaging services in 2008 (6). In fact, the high annual growth rates for both echocardiography and myocardial perfusion SPECT have attenuated after 2005 (Fig. 2) (3).

Identifying Clinical and Rational Causes for These Trends in CV Imaging Utilization

Following a roundtable discussion, the editors of *JACC: Cardiovascular Imaging* put forth several important considerations on the growth of imaging that focus on the concern over misinterpretation as solely overuse of testing services. At first glance, a review of the data that highlights the growth in CV imaging must also be placed within the context of total growth in imaging services including that of radiology, vascular surgery, orthopedic surgery, primary care, and urology. Throughout the years, Medicare payments for part B services to cardiologists have represented nearly one-fifth to one-third of all imaging payments (Fig. 1). The underlying rationale for imaging utilization remains ill defined, yet may be appropriate or related to clinical or health care system causes. The question re-

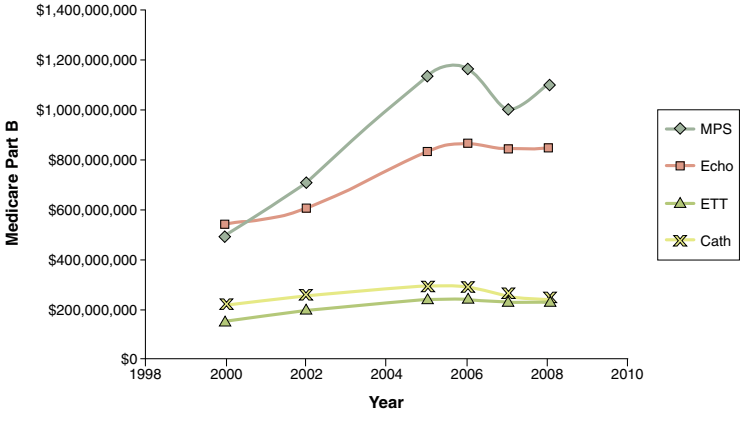

Figure 2. Medicare Part B Physician Payments for MPS, Echo, Cath, and ETT

Current procedural codes: MPS = 78,465, Echo = 93,307, ETT = 93,015, Cath (left heart catheterization) = 93,510. Adapted from Centers for Medicare & Medicaid Services (6). Cath = cardiac catheterization; Echo = echocardiography; ETT = exercise tolerance testing; MPS = myocardial perfusion single-photon emission computed tomography.

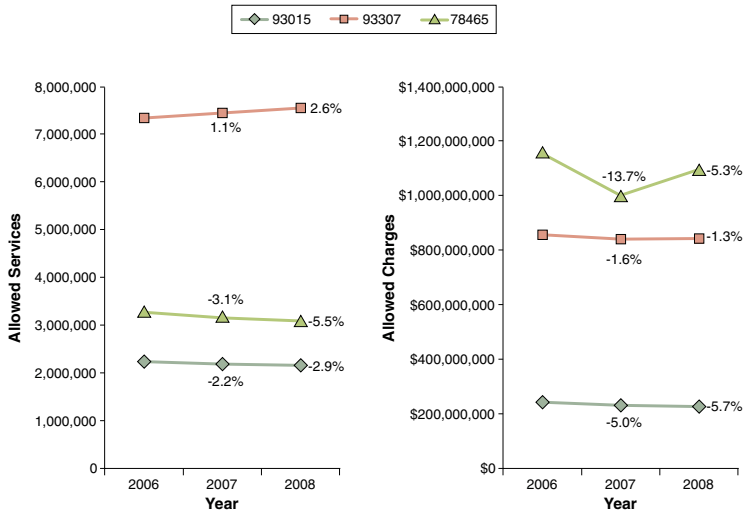

Figure 3. Top 200 Level I Current Procedural Terminology Codes

From 2006–2008, Medicare Part B Physician Utilization Data for the Top 200 Level 1 Current Procedural Terminology Codes Including Cardiovascular Stress Test (93,015), Echo (93,307), and MPS (78,465). The percent change in services and charges compare 2007 and 2008 to 2006 values. Adapted from http://www.cms.hhs.gov/MedicareFeeforSvcPartsAB/04_MedicareUtilizationforPartB.asp#TopOfPage. Accessed November 10, 2009. Abbreviations as in Figure 2.

mains as to whether hidden trends exist within imaging utilization that may have precipitated growth within the outpatient sector.

To answer this question, we reviewed a recent analysis of the change in the source of Medicare spending, which revealed interesting temporal changes (2). Over the last few decades, a large proportion of coronary heart disease spending shifted from inpatient hospitalizations to the outpatient setting (Table 2). From 1997 to 2006, there was a

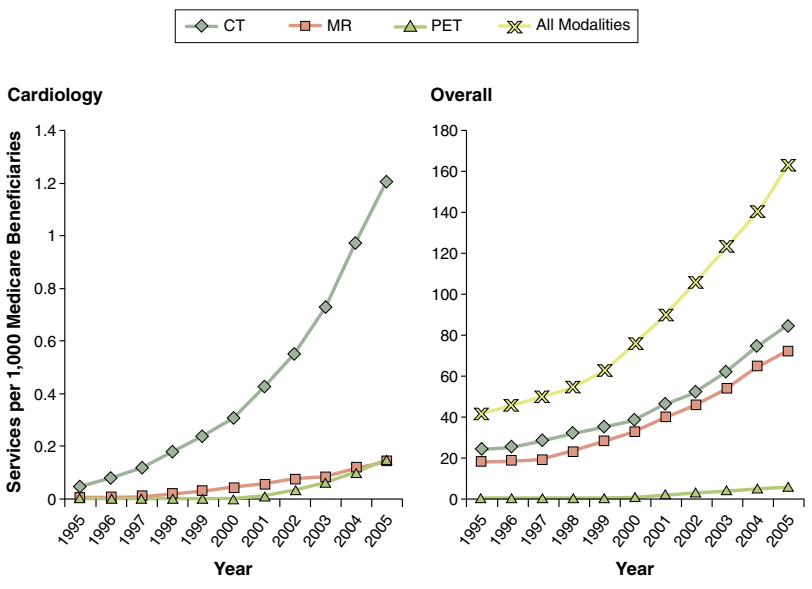

Figure 4. Growth in Advanced Imaging Utilization Services, Including CT, MR, and PET Imaging

Advanced imaging services provided by cardiologists and overall statistics from 1995 to 2005. Note the differential y axis ranges for cardiology **(left)** and overall **(right)** imaging utilization trends. Adapted from Department of Health and Human Services: Office of Inspector General (7). Abbreviations as in Figure 1.

Table 1. Utilization of Cardiac CT Based on the Centers for Medicare and Medicaid Services' Audited Utilization Files

CPT Code	Descriptor	2006	2007	2008
0144T	CT, heart, without contrast material, including image post-processing and quantitative evaluation of coronary calcium	1,016	5,757	4,805
0145T	CT, heart, without contrast material followed by contrast material(s) and further sections, including cardiac gating and 3D image post-processing; cardiac structure and morphology	1,533	2,269	2,041
0146T	CT angiography of coronary arteries (including native and anomalous coronary arteries, coronary bypass grafts), without quantitative evaluation of coronary calcium	14,394	33,832	22,673
0147T	CT angiography of coronary arteries (including native and anomalous coronary arteries, coronary bypass grafts), with quantitative evaluation of coronary calcium	10,512	31,630	21,431
0148T	Cardiac structure and morphology and CT angiography of coronary arteries (including native and anomalous coronary arteries, coronary bypass grafts), without quantitative evaluation of coronary calcium	4,288	14,033	11,600
0149T	Cardiac structure and morphology and CT angiography of coronary arteries (including native and anomalous coronary arteries, coronary bypass grafts), with quantitative evaluation of coronary calcium	6,384	20,936	15,418
0150T	Cardiac structure and morphology in congenital heart disease	44	71	41
Totals		38,171	108,528	78,009
Add-on code: 0151T	CT, heart, without contrast material followed by contrast material(s) and further sections, including cardiac gating and 3D imaging post-processing; function evaluation (left/right ventricular function, ejection fraction, and segmental wall motion)	13,909	42,405	31,000

Beginning on January 1, 2010, the category III "T" current procedural terminology (CPT) codes under which computed tomography (CT) was considered an emerging technology have been replaced by 4 new Category I CPT codes. *Utilization numbers from 2006 to 2007 from American Medical Association Relative Value Scale Update Committee database. Accessed November 12, 2009. **2008 utilization numbers from CMS Audited Utilization file. Accessed October 21, 2009.
3D = 3-dimensional.

764.7% decline in spending for inpatient care, coinciding with a 108.8% and 217.6% increase in expenditures for outpatient and also from referring physicians. Should this represent "true" cost shifting where, in lieu of hospitalization, many patients are now cared for in the outpatient setting with imaging playing a gatekeeper role in the decision to hospitalize. If true, this pattern of care could partly explain recent trends in imaging growth. As clinicians working within CV medicine, many clinical examples of these changes can be recalled. Yet, this report provides an important consideration that now requires further investigation in order to define causality in imaging growth.

Addressing Potential Strategies in Responding to the Imaging Epidemic

1. **Reduction in reimbursement.** While discouragement of imaging by driving reimbursement down to below the cost of the test will reduce the imaging budget, this may have important repercussions. Imaging is a means of identifying risk, and risk should guide therapeutic selection. The consequences of inappropriate treatment selection may dwarf the savings from reduced testing.
2. **Mandatory pre-authorization** and use of Radiology Benefits Managers, both of which are being considered by the Centers for Medicare and Medicaid Services (CMS) (3). It remains prudent to consider whether there are easy targets where the performance of imaging can be reduced without a decrement in quality of care. For example, in the recent American College of Cardiology (ACC) appropriate use criteria (AUC) myocardial perfusion SPECT registry, the number one reason for inappropriate referral was imaging of the low risk, asymptomatic patient (8). The elimination of this low risk cohort may contribute to an increase in the rates of appropriate testing. But, there will likely be ramifications due to the fact that imaging studies may often be performed to justify the absence of a subsequent investigation or treatment.
3. **AUC, such as those developed by the ACC** were initiated as a response to the use of

Table 2. Changes in Spending Growth Among Medicare Beneficiaries for Coronary Heart Disease Conditions as Compared to the Top 10 Conditions

	Physician Visits		Outpatient Visits		Inpatient Visits		Drug Treatment	
	1987–1997	1997–2006	1987–1997	1997–2006	1987–1997	1997–2006	1987–1997	1997–2006
Heart conditions	24.80	217.60	3.10	108.80	53.50	−764.70	11.90	244.10
Top 10 conditions	24.10	31.80	9.80	3.10	24.20	12.70	25.50	45.40

Adapted from Thorpe et al. (2).

pre-authorization strategies that often rely on proprietary algorithms to define appropriate imaging. Recently, a registry co-sponsored by the ACC and United Healthcare reported 66% of myocardial perfusion SPECT studies as appropriate (8). An additional 14% and 15% were considered either inappropriate or of uncertain appropriateness. Future utilization patterns appear to be focused on consideration of AUC as a means to define value-based imaging. In 2010, CMS will embark on a demonstration project using myocardial perfusion SPECT and evaluate the role of the ACC AUC as well as other available criteria, such as the American College of Radiology's appropriateness criteria, as a gatekeeper to image utilization in lieu of precertification programs (9). AUC may be used to reduce the contribution of defensive medicine as a contributor of growth. A recent program put forth by the ACC's national quality improvement campaign, titled Formation of Optimal Cardiovascular Imaging Utilization Strategies (FOCUS), seeks to enroll cardiology practices to self-report AUC and improve quality.

4. **Patient education.** Patient expectations must also be considered as this remains a very important driver of frequent imaging and one that is inadequately addressed in the published literature.
5. **Acceptance of growth for new clinical settings.** The growth in CV imaging must also be placed within the context of total growth in imaging services including that of radiology, vascular surgery, orthopedic surgery, primary care, and urology. Throughout the years, Medicare payments to cardiologists for part B services have represented nearly one-fifth to one-third of all imaging payments. As well, causality for imaging utilization remains ill defined, yet may be related to worsening health status, aging of the adult population, or the epidemic of obesity and diabetes in this country. Thus, the question remains as to whether clinical reasons exist for this growth. A comparison of the change in the proportion of affected adults who are elderly, obese, or diabetic far exceeds the change in utilization of imaging services. As an example, echocardiograms are now more often evaluating elderly patients post-operatively, those receiving chemotherapy, and those with atrial fibrillation, all increasingly prevalent conditions related to an aging population. There was general agreement by the *JACC: Cardiovascular Imaging* Editors that care for the elderly patient with frequent comorbidities now requires a greater complexity of CV services, including frequent and serial imaging assessments.
6. **Acceptance of growth as a trade-off against clinical costs.** New indications drive all CV imaging modalities, including the more recently devised modalities. For example, in coronary CT angiography, imaging growth in the acute evaluation of chest pain is largely driven by the fact that this modality is readily available, emergency department physicians rely on this modality for other evaluations, and a rapid diagnosis ensues, allowing for early discharge many hours sooner than that achieved with other diagnostic modalities. Thus, any future growth in cardiac CT angiography should be couched within the context of the setting or indication, as well as any offset in cost savings related to early discharge from chest pain units. This type of analysis is far more useful than the presentation of growth not within a clinical context. In addition, any increase in the use of CT angiography in this setting may come at the expense of other cardiac imaging procedures, including stress nuclear or echocardiography.
7. **Incorporation of specialty consultation.** The ordering of imaging tests by noncardiologists provides a unique aspect of the imaging growth problem in that the demand for testing is not only based on those performing the tests, but also in those referring physicians. Thus, it may be preferable to evaluate whether growth in imaging is driven at the point of testing or initiated by the referrer. For the generalist, the referral to imaging has largely supplanted the consultation. In a report by Pearlman et al. (10), more than 70% of referrals to echocardiography were from internists. The lack of acumen in physical examination on the part of generalists may be one source of an increasing trend toward reliance upon imaging to ascertain a diagnosis. In a multicenter, cross-sectional assessment of students and house staff (N = 453 physicians),

internal medicine and family practice residents correctly recognized only 20% of cardiac auscultatory events (11).

8. **Changes in the reimbursement model.** The current model requires considerable reform, including a movement away from a fee-for-service payment system toward that of a pay-for-performance or value-based imaging structure.

Needs for the Future

To form an accurate model of the sources for imaging growth, analyses are required to evaluate the contributory role of age and other disease-related factors in relation to nonclinical or financial considerations. A reasoned approach is required to employ such analyses; otherwise, imaging cuts will affect the quality of patient care. One example of an analysis that has yet to be delineated is a comparison of inpatient versus outpatient imaging growth, since there is no major incentive or referral bias for the cardiologist in the diagnosis-related groups–based hospital setting.

Critical to reform of our current system is the imperative to develop an imaging evidence base that justifies the cost of imaging based on the benefits of downstream decision making. What is desperately needed is more support for comparative effectiveness randomized trials of imaging-guided strategies to reliably guide healthcare coverage and medical necessity decisions. This is the optimal means to devise indications for testing and provide high-quality imaging-guided care.

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